found in fruits, in which it is modified by sugar and acids; that he has found it in great abundance in the juice of sloes, and that a friend of his had discovered its presence even in port wine. It also appears that it may exist in a state of combination in different substances, in which its presence cannot be made evident by the common means of solutions of gelatine; and that in these cases, in order to detect its existence, it may be necessary to have recourse to the action of diluted acids.

General Observations.—After a few strictures concerning a conjecture of Mr. Proust, that there are different species of the tanning principle possessed of different properties, and different powers of acting upon re-agents, from which our author thinks himself authorized to dissent, he draws the general conclusion,—that in all the different astringent infusions the tanning principle is found possessed of the same general properties and powers of combination. In all instances it is capable of entering into union with the acids, alkalies, and earths; and of forming insoluble compounds with gelatine and with skin. That in the processes of tanning, if the astringent infusion contain extractive and colouring matter, these as well as tannin enter into chemical combination with the skin; but that in no case is there any reason to believe that gallic acid is absorbed in this process. That hence the different qualities of leather made with the same kind of skin, seem to depend very much upon the different quantities of extractive and colouring matter it contains; the leather prepared by means of infusions of galls being generally found harder, and more liable to crack than that obtained from the infusions of bark.

When skins are slowly tanned in weak solutions of the barks, or of extract of catechu, it combines with a considerable proportion of extractive matter, whereby it is rendered perfectly insoluble in water, and yet soft and very strong. The inference, perhaps the most essential, deduced from this inquiry is, that of all the astringent substances as yet examined, the extracts of catechu are those that contain the largest proportion of tannin, half a pound of this extract being found to produce the same effect in tanning as from four to five pounds of common oak bark.

How material this must be in a country where oak timber is not an object of trivial importance, need not be here insisted upon.—The paper closes with a table, in which oak bark being taken as the standard of comparison as to its quantity of tannin, the different astringent substances are arranged in the order of their powers.

Account of some Experiments on the Descent of the Sap in Trees. In a Letter from Thomas Andrew Knight, *Esq. to the Right Hon. Sir* Joseph Banks, *Bart. K.B. P.R.S.* Read April 21, 1803. [*Phil. Trans.* 1803, *p.* 277.]

In a former paper Mr. Knight related some experiments on trees, from which he inferred that their sap, having been absorbed by the

bark of the root, is carried up by the alburnum, or white wood of the root, the trunk, and the branches; that it passes through what he calls the central vessels into the succulent part of the annual shoot, the leaf-stalk, and the leaf; and that it thence returns to the bark through the returning vessels of the leaf-stalk. The principal object of the present paper is to point out the causes of the descent of the sap through the bark, and the consequent formation of wood.

The causes to which he ascribes this descent are: 1. Gravitation; 2. Motion communicated by winds or other agents; and 3. Capillary attraction, and perhaps some peculiar circumstances in the conformation of the vessels themselves, which renders them better calculated to carry fluids in one direction than in another.

Before he proceeds upon the experiments from which he has deduced these conclusions, he premises a few observations on the functions of the leaf, from which all the descending fluids in the tree appear to be derived. He describes an experiment he made on a leaf of a vine, in which its lower surface being placed in contact with a clean piece of plate glass, this glass was soon found to be covered with a strong dew, which had evidently exhaled from the leaf; and at the end of half an hour so much water was found to have been discharged from the leaf, that it ran from the glass when it was held obliquely. The position of the leaf being then inverted, and its upper surface being brought in contact with the glass, not the slightest portion of moisture appeared, although the leaf was for some time exposed to the full influence of the meridian sun. Hence it is inferred, that the vessels intended for perspiration are confined to the under surface of the leaf, and that these, like the cutaneous lymphatics of the animal œconomy, are also capable of absorbing moisture when the plant is in a state to require it; whereas the upper surface seems chiefly formed for absorbing light; and if anything exhale from it, it is probably vital air, or some other permanently elastic fluid.

Reverting now to the principal object of his paper, the author describes an experiment on a shoot of a vine, which he bent downwards nearly in a perpendicular direction. After it had grown some time in this position, and acquired a ligneous texture, he stripped the bark from a part of it, and thus cut off all communication through the bark between the shoot and the parent stem. Former experiments have shown, that had this shoot grown in its erect position, the lip of the bark above the wound would have shown an accumulation of fresh wood and bark; but in this instance the contrary was found to be the case; the lip next to the stem, which by its position was now uppermost, gave evident signs of this accumulation. This is ascribed to the gravitation of the sap, from the curvature of the shoot down to the lip. The result of this experiment seems to point out one of the causes why perpendicular shoots grow with much greater vigour than those which are inclined or horizontal, they having probably a more perfect and rapid circulation.

The effect of motion on the circulation of the sap was deduced

from the following experiment. Several young standard apple-trees were, by means of stakes and bandages, prevented from yielding to the impulse of the wind up to about the middle of their stems, the upper parts of the stems and the branches being left in their free natural state. In the course of one summer it was found that much new wood had accumulated in the parts which were kept in motion by the wind; whereas the lower parts of the stems and roots had increased very little in size. One of these trees was afterwards confined in such a manner that it could only move in one direction, viz. north and south: thus circumstanced, the diameter of the tree from north to south, in that part of the stem which was most exercised by the wind, exceeded that in the opposite direction, in the following autumn, in the proportion of 13 to 11. Several curious inferences may be hence deduced as to the growth of trees in different situations.

In those which are exposed on high grounds, and are kept in almost continual motion, the sap circulates with great rapidity, and will be accumulated chiefly in the roots and lower parts of the trunk; and hence the diameter of the trunk will diminish rapidly as it recedes from the root: the progress of the ascending sap will of course be impeded, and it will thence cause lateral branches to be produced, the forms of which will be similar to that of the trunk; and thus the growth of an insulated tree on a mountain will be, as we always find it, low and sturdy, and well calculated to resist the heavy gales to which, from its situation, it is constantly exposed. Trees, on the other hand, which grow in clumps or sheltered situations, where, for want of motion, the sap is retarded both in its ascent and descent, will acquire a very different habit, and even their wood a different texture, insomuch that a great deal of the timber found in old buildings in and about London, which has always been considered as Spanish chestnut, appear on close examination to be most evidently forest oak. When a tree is wholly deprived of motion, it often becomes unhealthy, and not unfrequently perishes, apparently owing to the stagnation of the descending sap under the rigid confinement of the lifeless external bark. Stripping off this bark has been found singularly beneficial towards the increase both of the trunk and branches.

As to the third cause of the descent of sap, viz. the capillary attraction and peculiar conformation of the vessels, though the alburnum, consisting of such capillary tubes and vessels, appears manifestly to expand and contract under the various changes of temperature and moisture in the atmosphere; and though the motion thus produced must be in some degree communicated to the bark and other contiguous parts, yet combining the results of all his experiments, our author is inclined to consider gravitation as the most extensive and active cause of motion in the descending fluids of trees. An observation which corroborates his assertion is, that if the sap impelled by causes more powerful than gravitation were to pass and return as freely in the horizontal and pendent as in the perpendicular branches, the growth of each would be equally rapid, or nearly so;

and the horizontal branches would hence soon extend so far and become so bulky, as to render it impossible for the trunk to support them. The principal office here ascribed to the horizontal and spreading branches, is to nourish and support the blossoms and fruit, or seed; little or nothing of the sap being here returned to the parent tree, and hence very feeble powers being wanted in the returning system.

Our author had long entertained an opinion that the ascending fluids in the alburnum and central vessels are everywhere the same, and that the leaf-stalk, the tendril of the vine, the fruit-stalk, and the succulent point of the annual shoot, might in some measure be substituted for each other: experiments have proved his conjecture in many instances to be well founded. In several of these experiments, leaves continued to perform their office when grafted on the fruit-stalk, the tendril, and the succulent shoot of the vine; and the leaf-stalk, the tendril, and the fruit-stalk, equally supplied a branch grafted upon them with nourishment.

On examining the manner in which wounds in trees become covered, an additional proof was found, that the medullary processes, namely, the knobs of wood formed at the junction of a grafted bud, with the stock in which it is inserted, are like every other part of the wood generated by the bark. This is mentioned in contradiction to the opinion still entertained, that the hardest, most durable, and most solid part of the wood, is composed of the soft, cellular, and perishable substance of the medulla. Lastly, some observations are stated, which seem to imply that the sap in its descent may undergo some modification which fits it more effectually to produce wood.

A few remarks on the formation of buds in tuberous rooted plants beneath the ground, are added by way of appendix. These, if the above theory be true, must be formed of matter which has descended from the leaves through the bark. An experiment was made on a potatoe plant by intersecting its runners which connect the tubers with the parent plant, and immersing their ends in a decoction of logwood. In about twenty hours it was found that the decoction had indeed passed along the runners in both directions, but that none had entered the vessels of the parent plant. This result was not unexpected to the author, he being well aware that the matter by which the growing tuber is fed must descend from the leaves through the bark, and that bark cannot absorb coloured infusions.

Inquiries concerning the Nature of a metallic Substance lately sold in London, as a new Metal, under the Title of Palladium. By Richard Chenevix, *Esq. F.R.S. and M.R.I.A.* Read May 12, 1803. [*Phil. Trans.* 1803, *p.* 290.]

In April last, a printed notice was circulated concerning a substance to which the name of Palladium, or new silver, was assigned, and of which samples were offered for sale at Mr. Forster's, in Gerrard Street, Soho. A discovery of such importance did not fail to